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ART. VI.—*On the Crystallization of Brushite;* by JAMES D. DANA.

(Communicated to the California Academy of Sciences.)

THE crystals of the new mineral Brushite which I have had under examination were received from Mr. G. E. Moore, to whose chemical investigation science owes the first determination of the species.

The crystals are slender prisms, not over a third of an inch in length. A common form (containing all the occurring planes) is shown in the annexed figure. The prisms are monoclinic, and are often flattened parallel to the clinodiagonal, as here represented.

Cleavage is perfect parallel to the clinodiagonal section, or the plane $i\bar{i}$; also distinct, parallel to the lines cl, as apparent often in the cross fractures of crystals, and by occasional striæ. This plane of cleavage may be called the basal, or O.

The planes I and 1 are brilliant, especially the former. The oblique plane, situated on the back side in the figure, which may be called r, is quite rough, owing to an oscillatory combination of two hemi-octahedral planes. In many of the crystals, only the right one of the two planes I is present, and also only the left one of the two planes 1. The prisms frequently terminate above in an irregular edge made by the meeting of the one or two planes I and the rough plane r, and this edge is sometimes cut off, more or less deeply, by a single oblique plane, which is one of the planes 1.

According to measurements with the reflective goniometer—

$I : I = 142° 26'$	$1 : \bar{i}i = 101° 40'$
$I : \bar{i}i = 108\ 47$	$1 : 1 = 156\ 20$ (approximately.)

The inclination of 1 on 1 could not be accurately measured on account of the minuteness of the planes in the crystals in which both planes occur, and the want of perfection in the reflection. The angle obtained for $1 : i\bar{i}$ would give for 1:1 156° 40′.

By measurement with a goniometer attached to a compound microscope, the plane angle between the lines of cross cleavage, or cl, and the edge $I : I$ (which equals the inclination of O on the orthodiagonal section or the plane $i\bar{i}$) was found to be 117°–117½°; and that between edge $I : I$ and edge 1 : 1 (which equals $i\bar{i}$ on $1\bar{1}$, both unobserved planes), 95° to 95½°; whence, $O : 1\bar{1}$ would equal, approximately, 147° 30′. The inclination of the rough plane r on the edge 1 : 1 is about 110°, but varies much.

The results of calculation, taking as data the above-mentioned

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angles $I : I$ and $1 : \breve{a}$, along with the inclination of O to $\ddot{a} = 117° 15'$, and that of the edge $1 : 1$ (or $1\breve{a}$) to $\ddot{a} = 95° 15'$, are as follows:

$$C\ (= O : \ddot{a}) = 117° 15' \text{ and } 62° 45'$$

$$a \text{ (vertical axis)} : b \text{ (clinodiagonal)} : c = 0{\cdot}5396 : 1 : 2{\cdot}614$$

$$1 : 1 = 156° 46' \qquad -1 : -1 \text{ (unobserved planes)} = 164° 22'$$

The species is related in form to Vivianite, in which

$$a : b : c = 1{\cdot}002 : 1 : 1{\cdot}3843;$$

for, if we double the a of Brushite, and halve the c, we have for the ratio of its axes—

$$2a : b : \tfrac{1}{2}c = 1{\cdot}0792 : 1 : 1{\cdot}307.$$

The two species are also alike in the perfect and pearly clinodiagonal cleavage.

ART. VII.—*Introduction to the Mathematical Principles of the Nebular Theory, or Planetology;* by GUSTAVUS HINRICHS, Professor of Physics and Chemistry, Iowa State University.

THE *nebular hypothesis*—the boldest thought that ever elevated the human mind, by bringing us, as it were, in sight of the mysterious fiat of the Almighty—was, in its great general features, unfolded almost at the same time by Germany's deepest thinker, the Königsberg philosopher, IMMANUEL KANT, and by PIERRE SIMON DE LAPLACE, the greatest mathematician of France. It is truly the closing stone in the philosophy of the celestial vault; for Copernicus and Kepler made us behold the foundation,—the first, by placing the sun as the lantern of the world in the center, and surrounding it with the planets—the second, by destroying the cycles and unravelling the harmony of the spheres in his immortal laws; and after the existing phenomena had thus been rightly viewed, Newton made us behold the invisible bond that connects the members of the system, while at length Kant and Laplace pointed out to us the hand that at "the beginning" projected these celestial balls into space and thereby insured the continued existence of the system.

But notwithstanding this noble parentage and its being the *logical sequence* of the discoveries in the theory of cosmos made by Copernicus, Kepler and Newton, the nebular theory enjoys as yet but slight consideration among astronomers. Arago[1] is the only one of these who has deigned to consider it earnestly, and he probably did so more in his capacity as a physicist than as an astronomer.

[1] Arago, Astronomie Populaire, ii, 7. Paris and Leipsic, 1855.